

What we've begun to do, and must continue to do, is to get away from the idea that rain is wastewater—something to get rid of, to pass along to our neighbors downstream. We need to keep it where it falls, and the way to keep it is to get it back into the ground.

Roger Bannerman
Wisconsin Department of Natural Resources

MOLECULAR BIOLOGY

The Shape of Food Allergenicity

Every year, food allergies cause about 30,000 visits to emergency rooms and an estimated 150 deaths. The culprits are known; only eight foods—milk, eggs, peanuts, tree nuts, fish, shellfish, soybeans, and wheat—cause 90% of all allergic food reactions. But why do those foods cause allergies while others don't? A study

The results suggest that certain protein structures contribute to plants' allergenicity, says coauthor Clare Mills, head of the allergy research team at IFR. The next step is finding out which structures contribute, and how they do so.

Some of these common structures may make a protein very stable, and thus hard to digest. For instance, one of the four dominant families identified in this study, the cupin family, has barrel-shaped sections (the family gets its name from *cupa*, a Latin word meaning "barrel"). This shape makes the proteins very stable, Mills

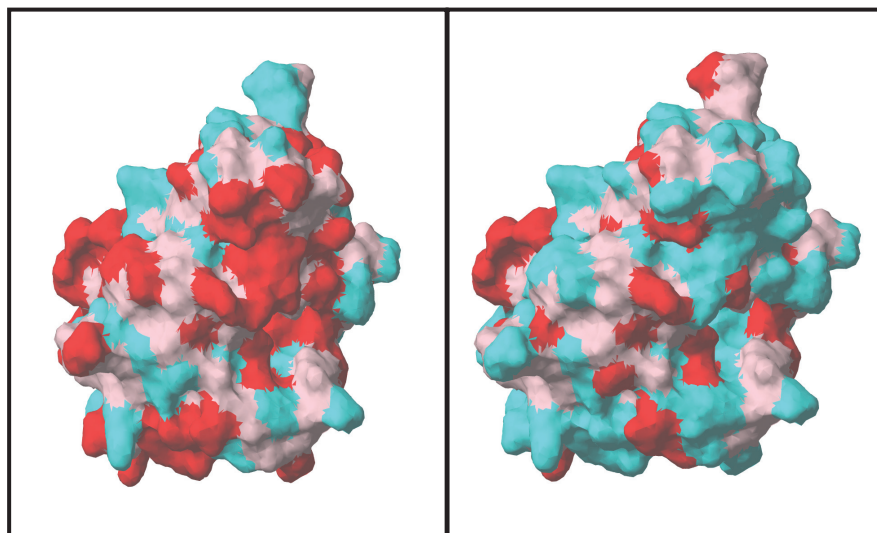
the major birch pollen allergen Bet v 1 to the related apple allergen Mal d 1], the shape of the molecule was very much the same."

According to Mills, the degree of change in the surface of the allergenic protein appears to correlate with the degree of allergic symptoms that people experience. A Bet v 1-related allergen, Api g 1, is found in celery, but its surface shape is altered more from Bet v 1 than that of the apple allergen. Similarly, people with birch pollen allergy can have cross-reactions to celery, but less often than they do to apples.

Mills and colleagues are conducting similar bioinformatics analysis of proteins in pollen and food allergens of animal origin to find out if these also show structural similarities. Although Mills says "it's not a focus of our research to come up with an *in silico* method of looking for allergens," she does say that categorizing proteins into structural families may also help in evaluating the potential allergenicity of proteins found in genetically modified foods. Many people are concerned that these engineered foods may introduce novel proteins that humans are unable to digest.

Stephen Howell, director of the Plant Sciences Institute at Iowa State University, agrees that the study suggests an additional parameter to be considered in evaluating novel proteins for allergenicity. Although new proteins introduced by genetic engineering are already tested extensively, he says that more knowledge can only help inform and improve that testing.

Richard Goodman, a research professor of food science and technology at the University of Nebraska–Lincoln, says that, in addition to bioinformatics tools, researchers may also need to use nuclear magnetic resonance spectroscopy or crystallography to examine tiny differences in surface structure to fully understand protein structures' role in allergenicity. Allergy is a complicated condition that depends on the amount of allergen present in a food, how often a person has been exposed to it, how many immune cells react to the allergen, and how strongly the cells react. "But," Goodman says, "this study does indicate that there might be more predictability to this than once thought." —Angela Spivey



Degrees of separation. In the above comparison of proteins from apples (left) and celery (right) to that from birch pollen, red areas show where surface structure has been conserved across the proteins. Given these two proteins' relative structural similarity to that of birch pollen, people allergic to birch pollen are more likely to also be allergic to apples than to celery.

in the January 2005 *Journal of Allergy and Clinical Immunology* suggests that the answer may lie partly in three-dimensional protein structures that are common to many different plants that cause allergies.

Scientists once thought that any protein could potentially become an allergen. In the current study, however, using a computer program to categorize 129 common plant food allergens, structural biologist John Jenkins of the British Institute of Food Research (IFR) and colleagues found that 65% of these proteins fell into just four structural families. The study used the protein families defined by Pfam, a database of protein structures housed at the Wellcome Trust Sanger Institute in the United Kingdom.

says, adding, "If a protein is resistant to digestion, there's more of it available for the immune antibodies to attack."

The authors also analyzed surface structures in proteins that are cross-reactive. One family of proteins, the Bet v 1 homologues, showed an unusual conservation of surface shapes across different plants. The scientists studied the family closely to learn more about that conservation and how it underlies the allergic cross-reactivity between birch pollen and plant foods such as apples and celery.

"Generally, proteins change quite a lot on their surface when you go across different species," Mills says. "But the Bet v 1 family is unusual. Although some of the amino acid residues changed [from

DRINKING WATER

NAS Reports on Perchlorate Safety

A National Academy of Sciences (NAS) panel has issued a final report on the health implications of perchlorate ingestion, recommending a reference dose of 0.0007 milligrams per kilogram (mg/kg) body weight. But the debate over the health risks posed by the chemical, used by the Department of Defense as a rocket fuel additive, is far from over.

Perchlorate compounds have been used since the early 1900s, and environmental perchlorate contamination was first seen in 1985 in wells at California Superfund sites. Since then, perchlorate has been found in 35 states. In May 2004 the U.S. Environmental Protection Agency (EPA) estimated that more than 11 million Americans were drinking water from public supplies containing at least 4 parts per billion (ppb) perchlorate.

Scientists agree that perchlorate can interfere with the production of thyroid hormone since it competes for the uptake of iodide by the thyroid gland. But beliefs about what level of exposure constitutes a health risk vary widely. The Council on Water Quality (CWQ), a chemical and aerospace industry group, often cites a drinking water cutoff of 245 ppb. In contrast, California recommends that drinking water contain no more than 6 ppb perchlorate, and Massachusetts recommends that pregnant women and children not consume water with more than 1 ppb perchlorate.

The broad disagreement, coupled with the prospect of massive cleanup costs—estimated by some to be in the billions—prompted the government to ask the NAS for guidance. According to panel chair Richard B. Johnston, Jr., associate dean for research development at the University of Colorado School of Medicine in Denver, the 15-member group used as its starting point a September 2002 *EHP* study headed by Monte A. Greer of Oregon Health & Science University. This study was partially funded by the Perchlorate Study Group, an organization created by the Department of Defense and some of its contractors.

The Greer study concluded there was no inhibition of iodide uptake by the thyroid at 0.007 mg/kg body weight. The panel applied a 10-fold uncertainty factor to that figure to derive its own reference dose. “We took what we feel is the most conservative end point,” says Johnston. “It’s way short of any kind of harm.” Five weeks after the NAS

made its report public, the EPA responded by adopting the NAS dose level and translating it into a drinking water equivalent level of 24 ppb.

But environmental groups have voiced heated disagreement with the NAS findings. Gina Solomon, a senior scientist at the Natural Resources Defense Council, says the report relied too heavily on a study she calls statistically flawed because of the small number of subjects (just 37). “As the effect [of perchlorate ingestion] gets more subtle, the size of the study group needs to be bigger to see if there’s an effect there or not,” she says.

Further, she says, the report suffers from tunnel vision: “[The NAS] should have been looking at the big picture on perchlorate, and they didn’t do that. The result was that their final report hinged entirely on one controversial industry study.”

Johnston responds that the panel also relied on four other clinical studies as well as several epidemiologic and perchlorate worker studies, all of which supported the Greer findings. And James Strock, a former secretary of the California Environmental Protection Agency who now works with the CWQ, says the NAS findings will provide state and federal regulators “a rare opportunity to promulgate regulations in a transparent manner, working simultaneously from information collected and considered by a world-class panel of experts.”

Johnston agrees, however, that more research will be helpful, especially on perchlorate’s effects on sensitive populations, such as pregnant women, nursing mothers, and infants. A study at Texas Tech University, published 1 April 2005 in *Environmental Science & Technology*, found that perchlorate levels in 36 samples of breast milk from nursing mothers in 18 states averaged 10.5 ppb, meaning the mothers were ingesting far more than 24 ppb. The study raises the possibility that some infants may be ingesting perchlorate at levels exceeding NAS and EPA safe doses.

Meanwhile, the controversy continues to play out, as described in an upcoming *EHP* commentary (doi:10.1289/ehp.8254, scheduled for publication in September 2005 and available in draft form at <http://dx.doi.org/>). Although the EPA has adopted the 24 ppb figure as an “official reference dose,” it’s not yet an enforceable standard, and Solomon says states are left to their own devices. “Some are following the EPA lead, and others are following the California lead,” she says. “This means that consumers in some states will be drinking water with higher levels of perchlorate than consumers in other states. And that’s unfortunate.” —Richard Dahl

“Cabin Fever” Fears Unfounded

Ever wonder how many infectious organisms are riding along with you in the cabin of a commercial airliner? According to a literature review in the 12 March 2005 *Lancet*, although airliner cabins are a suitable milieu for the spread of disease, the environmental control systems used by commercial aircraft appear to restrict the movement of airborne microbes. The review found that proper ventilation within cabins with one air exchange reduces concentrations of airborne organisms by 63%. Data models from a study of tuberculosis transmission aboard aircraft showed that doubling cabin ventilation rates reduced the infection risk by half. The paper’s authors point out that the fear of catching an infectious disease from a fellow passenger is greater than the actual risk.

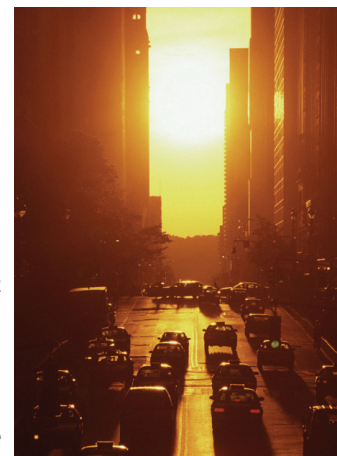


Betting on Biomass

The U.S. Department of Energy has unveiled a \$2.85 million Biomass Surface Characterization Laboratory within the National Renewable Energy Laboratory in Golden, Colorado. Dedicated in March 2005, the new lab is designed to give scientists the means to make significant breakthroughs in the development of biomass as a viable energy source. The facility features the most advanced research tools to study biomass-to-energy processes at the atomic and molecular levels. One area the laboratory will explore is the creation of new technologies for biorefineries, which will produce bio-based transportation fuels and various other products the way petroleum refineries do today.

Turning Up the Heat Watch

According to National Weather Service (NWS) data, excessive heat is the leading weather-related cause of death, with at least 1,500 excess deaths from heat-related causes during the average U.S. summer. The NWS has been testing its Heat/Health Watch Warning System to provide the public with five days’ advance notice of excessive heat events. Now the NWS has announced that the system, which has become a model for others worldwide, will be expanded to include every U.S. city with a population exceeding 500,000. In Philadelphia, the first city to implement the system, 117 lives were saved over three years.



ALLERGIES

Ionizing Air Cleaners Zapped

Ionizing air cleaners—those staples of infomercials and splashy magazine ads—are not only ineffective at removing contaminants from indoor air, but also may emit enough ozone to be a health concern. The effects may be even greater in people with respiratory problems, who make up 80% of the buyers of such devices. Those are the conclusions reached in tests of the units described in the May 2005 *Consumer Reports* (CR).

CR tested five units (including the top-selling Ionic Breeze from The Sharper Image) and confirmed results reported in October 2003 rating most of the air cleaners “poor” at removing dust and tobacco smoke from the indoor environment. This time around, pollen was added as well, with similarly disappointing results. The cleaners were also tested for generation of ozone, a respiratory irritant. The results showed that some of the least effective models also emitted potentially harmful ozone levels.

“We felt that it was particularly important to notify our subscribers that these air cleaners not only don’t remove particulates from the air, but they also put ozone into it,” says Jeff Asher, vice president and technical director of Consumers Union, the publisher of CR.

There is no regulatory standard for ozone emission by air cleaners; manufacturers claim to adhere to a voluntary standard of 50 parts per billion (ppb), a limit established by the Food and Drug Administration for medical devices. CR used Underwriters Laboratories

Standard 867 to measure the units’ ozone levels from 2 inches away in a sealed polyethylene room. All five machines failed that test.

To more accurately reflect actual use conditions, CR also tested the devices in an open laboratory, from distances of 2 inches and 3 feet. Two units failed this test; the other three (including the Ionic Breeze) produced levels of 26–48 ppb at 2 inches and 2–18 ppb at 3 feet—still high enough by CR’s estimation to be of concern. “The levels were not what I would call of great imminent risk,” says Asher, “but it was of significant risk in the sense of being in an indoor environment, where we just don’t need more ozone.”

The Sharper Image, which unsuccessfully sued CR over its 2003

report, has fired back, assailing the magazine’s credibility. In a 6 April 2005 press statement, CEO Richard Thalheimer called the article “irresponsible in the way it casually and unscientifically speculates about public health and safety. . . . We continue to emphatically disagree with Consumer Union’s methods in evaluating the Ionic Breeze.”

But health and engineering experts find the CR results troubling. “These levels make these devices inappropriate to use for asthmatic patients and for patients with respiratory disease,” says Peyton Eggleston, interim director of the Johns Hopkins Children’s Center.

Richard Shaughnessy, an environmental engineer at the University of Tulsa who has researched air cleaners for many years, concurs, pointing out that “not only are people with respiratory illnesses and asthma the population targeted by most of these air cleaners, they’re also the ones who are most likely to be adversely affected in terms of exposure to small amounts of ozone.” —Ernie Hood



Buyer beware. Ionizing air cleaners don’t always live up to manufacturer claims and may emit harmful levels of ozone.

POLICY

Framing a Chemical Future

Spurred by recent developments abroad to design new approaches to chemical management, the University of Massachusetts Lowell Center for Sustainable Production sponsored a two-day conference in April 2005 to stimulate similar productive changes in the United States. The event attracted a mix of some 170 environmentalists, government officials, academics, product representatives, and chemical industry representatives.

The conference aimed to initiate the kind of multi-stakeholder dialogue that the European Commission created in the late 1990s. The European effort has resulted in a draft regulation called REACH (Registration, Evaluation and Authorisation of Chemicals), which calls for manufacturers and importers to identify and report the properties of the substances they use and sell. Other international actions, such as the 2002 World Summit on Sustainable Development, which set a goal of achieving

sound global management of chemicals by 2020, have also heightened the need for better U.S. chemical policies. Discussions begun at this workshop may eventually lead to public policy supporting a safer and more competitive U.S. chemical industry.

Speakers opened the meeting with talks on the current thinking of chemical policy as well as specific policies and industrial protocols. Then participants broke out into workshops on various subjects. One group focused on the promotion of innovative industry initiatives, “green chemistry,” and alternative materials. Others dealt with improving information flows in supply chains and beyond, integration of U.S. and global chemical initiatives, and incorporation of improved chemicals management into business processes.

One theme repeated throughout the conference was the need for improved communication about what’s in the products that people buy, and greater transparency of the people who make the products. “The thing that I really noticed about [participant feedback] was the importance that people placed on information—the flow of information,

the access to information, who’s responsible, where it’s stored,” said center director Kenneth Geiser.

A second repeating theme was support for green chemistry, chemical processes that reduce or eliminate the use and generation of hazardous substances in economically viable ways. Paul Anastas, director of the Green Chemistry Institute in Washington, DC, said he noticed a recognition that such scientific innovations “can be both economically profitable and environmentally preferable.”

Geiser said there also was nearly universal agreement by participants that the current U.S. chemicals policy, largely embodied in the Toxic Substances Control Act of 1976, is outdated. “Almost everyone I talked to felt that the current chemicals policy system needs overhauling,” he said. “It’s interesting that the business folks felt the same way; it’s not working for them, either.”

The Lowell Center will compile a report on the conference in the next few months. Geiser believes the conference’s goal has been met. “I think we created an enthusiasm for moving forward,” he said. “That was pretty much what we wanted.” —Richard Dahl

ehpnet

UNEP.Net Freshwater Portal

Even though 70% of the Earth's surface is covered with water, little of that is freshwater. Today, one-third of the world's population lives in countries with moderate or high water stress, a fact that leads many experts to proclaim that water may possibly be the primary cause of international tensions and the foremost threat to environmental health in the twenty-first century. The United Nations Environment Programme (UNEP) has set up a Freshwater Portal, located online at <http://freshwater.unep.net/>, as a centralized resource for anyone looking to learn more about freshwater use, resources, and scarcity. The fully searchable site is part of UNEP's United Nations Environment



Network, which aims to bring specialized environmental science communities together under one umbrella.

The issues associated with freshwater resources are wide-ranging. Many surface water sources are shrinking, as population growth fuels desertification and overuse of resources. Several large rivers now run dry for at least part of the year, and lakes are shrinking. Groundwater, too, is being affected by pollution, salinization, and overuse. Overpumping of water is causing large areas to sink, including almost 60,000 square miles in China. Infrastructure also is in crisis

in many areas. In 2002, only 52% of people worldwide were connected to water systems, and only 30% were connected to sanitation services. Each year more than 5 million people die from water-related diseases, and diarrheal diseases are the leading cause of death in children.

The Freshwater Portal has been indexed by nine key issues. These include water scarcity, irrigated agriculture, water and sanitation, water quality, groundwater, transboundary water management, water and ecosystems, floods and droughts, and urban water. For each key issue, UNEP has collected relevant reports, background papers, websites, and other resources. For example, the Water Scarcity section includes links to papers on balancing water uses, managing water within agriculture, and the relationship between water scarcity and poverty. The Water and Sanitation section provides links to two reports as well as to the World Bank Water and Sanitation Program, which guides international efforts to build infrastructure in this area. And the Groundwater section links to a global overview of groundwater conditions, which goes on to detail best management practices for this resource.

The site is also cross-indexed by resource type. Visitors can view all case studies/best practices documents, for example, or go directly to conference proceedings covering multiple topic areas.

Similar portals on other topics are accessible from the top of the homepage. Visitors can choose other Thematic Portals, such as Climate Change or Urban Environment, and can also select from Regional Portals to view information specific to the Arctic, Europe, or Latin America. The homepage also highlights global water assessments and announcements of recent documents, statements, and meetings. Also included is a link to Earthprint.com, where visitors can purchase freshwater publications produced by UNEP and other international organizations. —Erin E. Dooley

Japan Revs Up Idling Law

Since 1997 Japan has required that drivers of commercial vehicles turn off their engines when they were going to be stopped for more than just a few moments—for example, at curbs and stoplights. Now, thanks to studies proving the measures' effectiveness in reducing carbon dioxide emissions and saving fuel, Japanese leaders plan to spread the movement to include private car owners. The Japanese Environment Agency calculates that if all 68.6 million cars owned in Japan idled for one less minute per day, more than 225,000 fewer tons of carbon dioxide would be emitted and 350 million liters of fuel would be saved.



Africa Forms Waste Institute

Despite international conventions to control the importation and transboundary movement of hazardous waste, African nations still struggle with huge problems of pesticide dumps and illicit trade in hazardous waste. Now 10 nations have signed an agreement under the auspices of the Basel Convention to establish an African institute to deal with waste issues. The institute will be hosted by South Africa, and will be legally established once five states ratify the agreement to create it. The institute will develop training programs for the environmentally sound management of hazardous and other wastes, as well as facilitate the transfer of technologies in this area. Work is under way to set up similar institutes for other areas of Africa.

The Lawn and Short of Mower Pollution

Not all lawn mowers are created equal, nor is all lawn mower pollution. From traditional gas-powered mowers to electric models, the amount of pollution produced varies significantly. A life cycle analysis done by University of Florida engineers confirms that gas-powered mowers produce more smog-forming pollution than their electric-powered counterparts. However, significantly more carcinogens and other toxicants may come from the manufacture and disposal of the batteries used in cordless electric mowers. Corded electric mowers, whose lifetime pollution consists of power plant emissions, were deemed least polluting of those tested.

